Final Report for Period: 10/2009 - 09/2010
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Principal Investigator: Peng, Liang .
Award ID: 0631608
Organization: GA Tech Res Corp - GIT
Submitted By:

Title:
Collaborative Research: Copulas, Tail Copulas, Garch and Extreme Values in Dependence Modelling and Risk Management

Project Participants

Senior Personnel

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Ngai-Hang Chan (Chinese University of Hong Kong)
Xiaohong Chen (New York University)
Yichuan Zhao (Georgia State University)
Deyuan Li (Fudan University)
Cindy Yu and SongXi Chen (Iowa State University)
Yongcheng Qi (University of Minnesota)
Dabao Zhang (Purdue University)
Ming-yen Chen (National Taiwan University)
Claudia Kluppelberg (Munich University of Technology)

Activities and Findings

Research and Education Activities:
The main research activities have been related to empirical likelihood methods for copulas, tail copulas, characteristic functions, high dimensional data, intermediate quantiles, modeling and sample fraction selection in tail copula and tail dependence function, endpoint estimation with particular applications in risk management.

Findings:
Our main findings are as follows.

i) We propose to model tail copulas via elliptical copulas, which results in an explicit formula for tail copulas. The inference involves estimating tail parameter by samples in the far tail region and some parameter by the whole sample. Therefore, this modeling is a sort of robust.

Moreover, it is easy to simulate and generalize to high dimension. We all propose a goodness-of-fit test for such modeling and applications to some financial data sets can not reject such models. Hence, this modeling is practically useful.

ii) In the estimation of a tail copula or tail dependence function, one importance issue is how to select threshold, i.e., when data is in the tail. We propose a very practical way to choose the sample fraction as larger as possible, but at the optimal rate, and then propose a bias reduction estimation. This bias reduction estimator with the data driven sample fraction can be used to conduct both interval and point estimation simultaneously.

iii) Empirical likelihood method is employed to construct confidence interval for a copula. The chi-squared limit is developed and simulation study shows the advantage of such procedure.

iv) We extend the results of Jackknife variance estimation and empirical likelihood method for quantiles to intermediate quantiles. These extensions make the computation of Value-at-Risk more consistent. We also propose empirical likelihood method for estimating conditional value-at-risk based on GARCH models, which is useful in risk management.

v) We derive the asymptotic limit for the multivariate GARCH models when errors are modeled by a copula.

Training and Development:

Applications of these results were made to insurance data, financial data, etc. A proposal in applying to enviromental sciences was submitted to NSF without success. A revised version will be submitted again.

The project provided research time for the Principal Investigator to: advise Ph.D. students (Gong Yu, Ruodu Wang, Huijun Feng), and host research visitors (Professors Zhengyan Lin, Zhengjun Zhang, Ming-Yen Cheng, Jonathan Hill, Deyuan Li, Qiman Shao, Ming Dai, Zongwu Cai, Ingrid Van Keilegom).

Outreach Activities:

The outreach activities of this project have included talks at conferences in Georgia, San Fransisco, Ottawa, Florida and visiting collaborators in ShangHai, London and Lisbon.

Journal Publications

L. Peng and Y. Qi, "Bootstrap approximation of tail dependence function", Journal of Multivariate Analysis, p. 1807-1824, vol. 99, (2008). Published,

L. de Haan, C. Neves and L. Peng, "Parametric tail copula estimation and model testing", Journal of Multivariate Analysis, p. 1260-1275, vol. 99, (2008). Published,

N.H. Chan, J. Chen, X. Chen, Y. Fan and L. Peng, "Statistical inference for multivariate residual copula of GARCH models", Statistica Sinica, p. 53-70, vol. 19, (2000). Published,

J. Chen, L. Peng and Y. Zhao, "Empirical likelihood based confidence intervals for copulas", JMVA, p. 137-151, vol. 100, (2009). Published,

Claudia Kluppelberg, Gabriel Kuhn and Liang Peng, "Multivariate tail copula: modeling and estimation", Scandinavian Journal of Statistics, p. , vol. , (2008). Accepted,

L. Peng and Y. Qi, "Maximum likelihood estimation of extreme value index for irregular cases", JSPI, p. 3361-3376, vol. 139, (2009). Published,

L. Peng, "A practical way for analyzing heavy tailed data", Canadian Journal of Statistics, p. 235-248, vol. 27, (2009). Published,

S. X. Chen, L. Peng and Y. Qin, "Empirical likelihood methods for high dimension", Biometrika, p. 711-722, vol. 96, (2009). Published,

Liang Peng, "A practical way for estimating tail dependence functions", Statistica Sinica, p. , vol. , (2008). Accepted,

L. Peng and J. Yang, "Jackknife method for intermediate quantiles", Journal of Statistical Planning and Inference, p. 2373-2381, vol. 139, (2009). Published,

Deyuan Li and Liang Peng, "Does Bias Reduction with External Estimator of Second Order Parameter Work for Endpoint?", JSPI, p. 1937-1952, vol. 139, (2009). Published,

Lu-Hung Chen, Ming-Yen Cheng and Liang Peng, "Conditional variance estimation in heteroscedastic regression model", JSPI, p. 236-245, vol. 139, (2009). Published,

J. Chen, L. Peng and Y. Zhao, "Empirical likelihood based confidence intervals for copulas", JMVA, p. 137-151, vol. 100, (2009). Published,

D. Li, L. Peng and J. Yang, "Bias reduction for high quantiles", JSPI, p. 2433-2441, vol. 140, (2010). Published,

Zhouping Li, Yun Gong and Liang Peng, "Empirical likelihood method for intermediate quantiles", Statistics and Probability Letters, p. , vol. , (2010). Accepted,

V. Asimit, D. Li and L. Peng, "Pitfalls in using Weibull tailed distributions", JSPI, p. 2018-2024, vol. 140, (2010). Published,

Ngai-Hang Chan, Liang Peng and Dabao Zhang, "Empirical likelihood based confidence intervals for conditional variance in heteroscedastic regression models", Econometric Theory, p. 1-24, vol. 27, (2010). Published,

Han-Ying Liang and Liang Peng, "Asymptotic normality and Berry-Esseen results for the kernel estimator under censored and dependent data", JMVA, p. 1043-1054, vol. 201, (2010). Published,

Deyuan Li and Liang Peng, "Compare extreme models when the sign of the extreme value index is known", Statistics & Probability Letters, p. 739-746, vol. 80, (2010). Published,

Yun Gong, Zhouping Li and Liang Peng, "Empirical Likelihood Intervals for Conditional Value-at-Risk in ARCH/GARCH Models", JTSA, p. 65-75, vol. 31, (2010). Published,

N.H. Chan, T. Lee and L. Peng, "On nonparametric local inference for density estimation", Computational Statistics and Data Analysis, p. 509-515, vol. 54, (2010). Published,

Y. Gong and L. Peng, "Coverage accuracy for a mean without third moment", JSPI, p. 1082-1088, vol. 104, (2010). Published,

L. Peng, "A practical way for estimating tail dependence functions", Statistica Sinica, p. 365-378, vol. 20, (2010). Published,

N.H. Chan, S.X. Chen, L. Peng and C.L. Yu, "Empirical likelihood methods based on characteristic functions with applications to Levy processes", Journal of the American Statistical Association, p. 1621-1630, vol. 104, (2009). Published,

Deyuan Li and Liang Peng, "Goodness-of-fit test for tail copulas modeled by elliptical copulas", Statistics & Probability Letters, p. 1097-1104, vol. 79, (2009). Published,

A. Koning and L. Peng, "Goodness-of-fit tests for a heavy tailed distribution", Journal of Statistical Planning and Inference, p. 3960-2981, vol. 138, (2008). Published,

Dabao Zhang, Martin T. Wells and Liang Peng, "Nonparametric estimation of the dependence function for a multivariate extreme value distribution", Journal of Multivariate Analysis, p. 577-588, vol. 99, (2008). Published,

Claudia Kluppelberg, Gabriel Kuhn and Liang Peng, "Semi-Parametric Models for the Multivariate Tail Dependence Function - the Asymptotically Dependent Case", SJS, p. 701-718, vol. 35, (2008). Published,

Books or Other One-time Publications

Web/Internet Site

URL(s):
http://www.math.gatech.edu/~peng/
Description:
To further enhance the dissemination of research supported by this grant, the papers that are listed in this report are posted at the URL and all the papers acknowledge NSF support.

Other Specific Products

Contributions

Contributions within Discipline:
The results on empirical likelihood methods, extreme value theory, time series, copulas, tail copulas have led to 25 journal publications and open new ideas for other grant proposals.

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Conference Proceedings

Categories for which nothing is reported:

Organizational Partners
Any Book
Any Product
Contributions: To Any Other Disciplines
Contributions: To Any Human Resource Development
Contributions: To Any Resources for Research and Education
Contributions: To Any Beyond Science and Engineering
Any Conference